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THE FIFTH ESTATE[1]

BENJAMIN FRANKLIN was not perhaps in all respects a paragon, but he was unquestionably a polygon—a plain figure with many sides and angles. There were not enough buttons on his black coat to tell off the multifarious aspects in which his complex personality was presented to the world. He was craftsman and tradesman; philosopher and publicist; diplomat, statesman and patriot. And he was, withal, a very human being. What concerns us particularly on this occasion is the fact that he was at once philosopher and man of affairs. His remarkable career should refute forever the fallacy, which, unfortunately, still is current, that the man of science is temperamentally unfitted for the practical business of life.

At the time when Franklin was in England the British Parliament was assumed to be composed of representatives of three estates: the lords spiritual, the lords temporal and the commons, but Edmund Burke, pointing to the Reporters' Gallery, said, "There sits a *Fourth Estate,* more important far than they all." No one at all familiar with the ubiquitous influence and all-pervading power of the press would to-day question the validity of Burke's appraisal. Even then, however, there was present in England in the person of Benjamin Franklin a prototype and exemplar of the membership of a *Fifth Estate,* an estate destined to play an even greater part than its predecessors in the remaking of the world.

This Fifth Estate, to which your attention is appropriately invited on the centenary of the Franklin Institute, is composed of those having the simplicity to wonder, the ability to question, the power to generalize, the capacity to apply. It is, in short, the company of thinkers, workers, expounders and practitioners upon which the world is absolutely dependent for the preservation and advancement of that organized knowledge which we call science. It is their seeing eye that discloses, as Carlyle said, "the inner harmony of things; what Nature meant." It is they who bring the power and the fruits of knowledge to the multitude who are content to go through life without thinking and without questioning, who accept fire and the hatching of an egg, the attraction of a feather by a bit of amber, and the stars in their courses as a fish accepts the ocean.

[1] Delivered in connection with centenary celebration of the founding of the Franklin Institute and the inauguration exercises of the Bartol Research Foundation on September 19, 1924.

The curious deterioration to which words are subject has left us with no term in good repute and common usage by which the members of the Fifth Estate may properly be characterized. Sophists are no longer distinguished for wisdom: they are now fallacious reasoners. Philosophers, who once claimed all knowledge for their province, are now content with speculative metaphysics. Scholars have become pupils. The absent-minded and myopic professor is a standardized property of the stage and screen. The expert, if not under a cloud, is at least standing in the shade. In Boston one hesitates to call a professional man a scientist, he may be a Presbyterian; and a "sage," as an anonymous writer has pointed out, "calls up in the average mind the picture of something grey and pedantic if not green and aromatic." Let us, therefore, for a time at least, escape these derogations and identify ourselves as members of the Fifth Estate.

Although the brotherhood of the Estate is open to all the world, its effective membership nowhere comprises more than an insignificant proportion of the population. Two hundred and fifty constitute the membership of the National Academy of Sciences. The latest edition of "American Men of Science" includes only about 9,500 names. The number is expanded to 12,000 on the roll of the American Association for the Advancement of Science. Although gathered from all countries and though chemistry is one of the most active and inclusive sciences, the chemical papers, books and patents reviewed in *Chemical Abstracts* in 1923 were the product of about 22,000 workers. One may hazard the estimate that there are not in all the world 100,000 persons whose creative effort is responsible for the advancement of science.

The studies of Cattell indicate that in America, at least, the great majority of men of science come from the so-called middle and upper classes, or precisely those sections of society which, in Russia, have been practically exterminated in the name of the new Social Justice. In about two thirds of Cattell's reported cases both parents were American-born, while the fathers of nearly one half were themselves professional men. Seventy-five per cent. are dependent upon the universities for support, from which we may assume that the burden of the higher surtaxes does not bear heavily upon the Fifth Estate.

In proportion to population the cities have produced twice as many scientific men as the country, but how many "hearts once pregnant with celestial fire" repose in country churchyards because of lack of opportunity and absence of the stimulus of contact can not, of course, be known, nor can we tell how many brains competent and equipped to penetrate the mysteries of nature the war has cost the world.

Initiative is one of the rarest mental qualities, yet without it progress is impossible. Its combination with the scientific imagination and command of fact is still rarer and more precious. Since comparatively few of those who study science develop the capacity to extend its borders the cost of a man competent to advance science has been estimated at $500,000 and his value to the community set at a far greater figure. Full membership in the Fifth Estate thus seems to involve the highest initiation fee on record. It is a figure disconcerting to the candidate, but as Wiggam has finely said: "Only genius can create science, but the humblest man can be taught its spirit. He can learn to face truth."

That the Fifth Estate is not better appreciated or always understood by the world at large is not surprising. In their endeavors to secure accuracy of definition and expression its members have evolved a preposterous and terrifying language of their own. It is not ideally adapted to the interchange of confidences in ordinary human intercourse. It does not lend itself to poetry. "Ladybird, ladybird, fly away home" becomes impossible when one is forced to address the prettily spotted beetle as *Coccinella dipunctata*. A primrose by the river's brim is much more than a yellow primrose to the botanist: it is a specimen of *Primula vulgaris*. The organic chemist produces a new synthetic product in a mass of pilular dimensions and bestows upon it a name that would slow up Arcturus. Nothing but static interference can account for the terms of radio telephony. If knowledge is to be humanized it must first be translated.

Dewar has said that the chief object of the training of a chemist is to produce an attitude of mind. It should be the object of all education to produce the scientific attitude toward truth. We may even agree with Robinson that "of all human ambitions an open mind, eagerly expectant of new discoveries and ready to remould conviction in the light of added knowledge and dispelled ignorances and misapprehensions, is the noblest, the rarest and the most difficult to achieve."

Carlyle says, "The degree of vision that dwells in a man is a correct measure of the man." And President Coolidge has been quoted as saying in a recent interview:

> Everything that flows from the application of trained intelligence and invested capital is the result of brains. . . . The man of trained intelligence is a public asset. . . . We go forward only through the trained intelligence of individuals but we, not the individuals, are the beneficiaries of that trained intelligence. In the very nature of things we can not all have the training but we can all have the benefits.

Now vision, a trained intelligence and an open mind are the qualities which characterize all those who are worthy of membership in the Fifth Estate. They are qualities which the many-sided Franklin possessed in exceptionally high degree.

Among all the activities with which his busy life was crowded Franklin undoubtedly found his greatest pleasure in the pursuit of science, and in that pursuit he followed the eclectic method. At a time when nearly everything awaited explanation his focused attention ranged like a searchlight over many fields. He observed the movement of winds and developed a theory of storms. He considered ventilation and the causes of smoky chimneys and proceeded to invent new stoves. He introduced the Gulf Stream to Falmouth skippers and demonstrated the calming effect of oil on turbulent seas to officers of the British Navy at Portsmouth. From earthquakes he turned to the heat absorption of colored cloths and the fertilizing properties of gypsum. He wrote on sun spots and meteors, waterspouts, tides and sound. The kite, which for centuries had been the toy of boys, became in Franklin's hands a scientific instrument, the means to a great discovery. That its significance is, even now, not universally appreciated is shown by the recent answer of a schoolboy, "Lightning differs from electricity because you don't have to pay for lightning." To Franklin, as the child of every man knows, we owe our initial conceptions of positive and negative electricity and he was the first to suggest that the aurora is an electrical phenomenon.

The gregariousness, which is a prominent characteristic of the Fifth Estate, found early expression in Franklin. He formed The Junta, a club for the discussion of morals, politics and natural philosophy, and in 1744 drew up a proposal for the organization of the American Philosophical Society, of which later he became president. He established a wide acquaintance and cemented many firm friendships among the foremost scientific men of France and England, by whom he was received on equal terms. In 1753 he was awarded the Copley medal of the Royal Society for his discoveries in electricity and on his leaving England, David Hume wrote: "I am sorry that you intend soon to leave our hemisphere. America has sent us many good things, gold, silver, sugar, tobacco, indigo, but you are the first philosopher and indeed the first great man of letters for whom we are beholden to her."

The professional spirit which animates the Fifth Estate is essentially one of service. Its compelling urge in the search for truth springs from the conviction that the Truth shall make men free. That spirit finds complete expression in Franklin's statement, "I have no private interest in the reception of my inventions by the world, having never made nor proposed to make the least profit by any of them." This impersonal relation to the children of his brain was indeed carried by him to an extent which ordinary human nature would find hard to emulate. "I have," he writes, "never entered into any controversy in support of my philosophical opinons; I leave them to take their chance in the world. If they are right, truth and experience will support them; if wrong, they ought to be refuted and rejected."

There is, nevertheless, a place for militancy in science. The world needs a Huxley for every Bryan.

Franklin was a man of science, but his career proclaims that it is possible to be a man of science and much more besides. Science was made for life and life is more than science. Art in its fullest expression may touch deeper springs, human relations and affections may bring richer rewards, and public affairs may make a more imperious claim. With Franklin as their prototype the members of the Fifth Estate may well strive to emulate his devotion to the public service and his broad and constructive interest in human problems and affairs.

Error and misconception have a feline tenacity of hold upon life, and the Fifth Estate, though richly endowed with latent executive capacity, is still in popular opinion regarded as equipped for thought rather than for action. The practical man, busily engaged in repeating the errors of his forefathers, has little time and less consideration for the distracting theories and disconcerting facts of the man of science. Yet who, among the men of action, is more intensely and truly practical than Carty, Baekeland, Reese or Whitaker? Where shall one find a firmer grasp on the details of business than that possessed by E. W. Rice, Jr., Gerard Swope or Dr. Nichols? What quality caused the young director of a research laboratory to find himself responsible for the production of gas masks to protect four million fighting men? In a time of dire emergency it was a professor of chemistry who organized the great Edgewood Arsenal and developed the means and methods and the trained personnel required to supply munitions for a new type of warfare. It was not to a statesman or a business man or a great manufacturer that the Allies entrusted the supreme command. It was to a teacher in a French military school. The range and value of their public service obscures the fact that Charles W. Eliot was a professor of chemistry and that Hoover is an engineer. The League of Nations is the child of a schoolmaster.

Numerically the Fifth Estate has always been feeble and insignificant. Its total membership at any time could be housed comfortably in a third-rate city. No politician makes a promise or invents a phrase to attract its scattered and ineffective vote. Rarely do its

members sit in Congress: when they do they sit in the gallery.

With less political influence than the sparse population of Nevada the Fifth Estate has recast civilization through its study and application of "the great and fundamental facts of Nature and the laws of her operation." It has opened out the heavens to depths beyond imagination, weighed remote suns and analyzed them by light which left them before the dawn of history. It has moved the earth from the center of the universe to its proper place within the cosmos. It has extended the horizon of the mind until its sweep includes the 30,000 suns within the wisp of smoke in the constellation Hercules and the electrons in their orbits within the atom. It has read the sermons in the rocks, revealed man's place in nature, disclosed the stupendous complexity of simple things, and hinted at the underlying unity of all.

Because of this new breadth of vision, this lifting of the corner of the veil, this new insight into the hidden meaning of the things about him, the mind of man, cramped for ages by taboos and bound by superstition, is emerging into freedom: into a new world rich in promise and of surpassing interest and wonder.

Man brought nothing into the world and through long and painful ages he added little to that nothing: a club, an ax of stone, a pebble in a sling, some skins of beasts, a rubbing of sticks for a fire. He might labor, but to what avail? Even to-day the South American Indian works incessantly, yet his labor produces little more than heaps of stones. To those who would have us believe that all wealth is produced by labor the Fifth Estate replies, "Wealth is the product of brains, and labor is productive only as it is guided by intelligence."

Science is the great emancipator of labor. Bagehot has somewhere said, perhaps in "Physics and Politics," that, during the early stages of civilization, slavery was essential to progress because only through the enforced labor of the many could the few have leisure to think. To-day, in the United States, the supply of available energy is equivalent to sixty man power for every man, woman and child. There is now leisure for all to think, but the millions prefer the movies.

It is not labor but the trained intelligence of the Fifth Estate which has endowed man with his present control of stupendous forces. It has solved problems that for ages have hindered and beset mankind. It has revealed great stores of raw materials, synthesized scores of thousands of new compounds, furnished the fundamental data which find embodiment in machines and processes and in those agencies of transportation and communication that have made of the world a neighborhood. It has enabled man effectively to combat disease, added years to the average life, and made it better worth the living.

Benjamin Franklin died in 1790—one hundred and thirty-four years ago. Could he return to make appraisal what wonders would confront his astonished vision, what triumphs of the Fifth Estate compel his admiration!

Electricity, which to his contemporaries was little more than an obscure force, the curious manifestations of which might supply an evening's entertainment, has become the structural basis of the universe. The atom of Democritus is now a microcosm, vibrant with energy that glows in the white light of the electric lamps, which have replaced the tallow dip. In place of the electrophorus and the charges of the Leyden jar he would find in our own country alone twenty-seven million horsepower driving generators in thousands of stations from which electric energy is distributed to our homes and factories and transportation lines to perform innumerable services. Imagine, if you can, the stunning impact of the impressions that would crowd the day of his return. With what amazement would he converse over a wire from Philadelphia to San Francisco or hear a voice transmitted through the ether from a point halfway around the world. So commonplace a thing as a street car would leave him open-mouthed with wonder, which might well increase at sight of an electric locomotive, hauling its hundreds of tons of freight.

In great industrial plants he would find electricity driving machines of an intricacy, precision and productive power beyond the imagination of his generation, or at work in decomposing cells and in the heart of glowing furnaces fashioning new products. In university and corporation laboratories would be revealed to him the marvels of the X-rays, photography, the fascinating world of the microscope, balances weighing 1/100,000th of a milligram, the spectroscope and all those instruments of precision and research which are the tools of the Fifth Estate. Elements unknown to him would be placed in his hand; fascinating experiments performed to demonstrate properties and relationships beyond his dream. The air, which he studied with reference to winds, combustion and ventilation, would be reduced before him to a liquid as obvious as water, though boiling on a cake of ice.

Where once the postboy and the post chaise were familiar he would find our roads crowded with automotive vehicles and the country gridironed by the railways. Did he wish to send a letter across the continent, he would have only to commit it to the air mail to ensure its arrival in thirty-six hours. Were he called upon to revisit England, there would be no ten-weeks' voyage in a sailing packet, but the speed and luxury of a 50,000-ton liner, oil fired and turbine driven. At Portsmouth, where he calmed the waves

with oil, he would find, instead of wooden frigates and smooth-bore cannon, submarines and armored superdreadnaughts, a single gun of which could sink the entire British Navy as he knew it. Did he wish to proceed to Paris, he would have only to take passage in an aeroplane.

The gardeners Franklin knew grew peas for pleasure or profit. Mendel grew them and established the laws of heredity. Farming, which was a wholly empirical occupation, is now the special concern of a great governmental department devoted to the development of scientific agriculture. Here Franklin would learn of soil analysis and seed selection, of hardier and more prolific varieties of plants, of better breeds of animals, of methods of control of such virulent diseases as splenic fever, anthrax, hog cholera and bovine tuberculosis. He would find his own experiments with gypsum extended to cover the whole field of chemical fertilizers, the air itself converted into an inexhaustible reservoir of plant food, and the efficiency of farm labor multiplied many times by ingenious agricultural machines.

He would find household economics revolutionized: the town pump replaced by running water; electricity a servant in the house; the food supply broadened and stabilized; domestic drudgery assumed by laundry, bakery and factory; tasteful clothing within the reach of all; transportation and amusement for the multitude, and the history of yesterday sold for a penny. Innumerable new industries based on the findings of the laboratory now offer the means of decent livelihood to millions and open careers to thousands.

In great hospitals, permeated with the scientific spirit and equipped with many new and strange devices for the alleviation of human suffering, he would hear of the incalculable benefits which medical and surgical science have conferred upon mankind. He would see the portraits and listen to the story of Pasteur and Lister and Loeb and Ehrlich. We know to-day with what joy and relief the world would welcome a veritable cure for cancer, but we can little realize the emotion with which one like Franklin would learn in a single afternoon of the germ theory of disease, of preventative serums, of antisepsis, of chemotherapy, of the marvelous complexity of the blood stream and the extraordinary influence and potency of the secretions of the ductless glands. What appraisal would he make of the service to humanity which, in little more than a generation, has mitigated the horrors of surgery by the blessings of anesthesia and antisepsis, which has controlled rabies, yellow fever, typhoid fever, tetanus, which is stamping out tuberculosis, curing leprosy, and providing specifics for other scourges of the race. What values would he put on insulin, thyroxin, adrenalin. The physician is no longer compelled to rely on herbs and simples and drastic mineral compounds of doubtful value and uncertain action. Compounds of extraordinary potency, isolated or synthesized by the chemist, are now available to allay pain, correct disorders, prolong life and even to restore mentality and character.

With contributions to their credit which have so enriched and stimulated the intellectual life; which have brought the peoples of the earth together into closer touch than English shires once were; which have revolutionized industry, enlarged the opportunity of the average man, and added so greatly to his comfort and well-being, we may reasonably inquire, "What are the recompenses of the Fifth Estate?"

On the material side they have almost invariably been curiously inadequate and meager. It is incomparably more profitable to draw the Gumps for a comic supplement than to write "The Origin of Species." There is more money in chewing gum than in relativity. Lobsters and limousines are acquired far more rapidly by the skillful thrower of custard pies in a moving-picture studio than by the no less skillful demonstrator of the projection of electrons. The gate receipts of an international prize fight would support a university faculty for a year.

One may recall that Lavoisier was guillotined by a republic that "had no need of chemists," that Priestley was driven from his sacked and devastated home, that LeBlanc, after giving the world cheap alkali, died in a French poorhouse, that Langley was crushed by ridicule and chagrin in his last days. A month before the war who could have believed that within a few years the Fifth Estate in Russia would be utterly destroyed and in Germany and Austria existing at the very edge of starvation. What has happened there may happen again elsewhere if the intelligence of the world does not assume and hold its proper place in the direction of national and world affairs.

In the preface to his recent "Lehrbuch der Photochemie" Professor Plotnikow has written: "Home and property were pillaged by bands of idle Russians who used my library for cigarette papers. Hunger, misery, want and personal insecurity, often approaching fear for my life, were the constant accompaniment of my labors."

One is reminded that Carlyle, on the authority of Richter, says: "In the Island of Sumatra there is a kind of 'light-chafers,' large fireflies, which people stick upon spits, and illuminate the ways with at night. Persons of condition can thus travel with a pleasant radiance, which they much admire. Great honor to the fire-flies, but — ! —"

It is not becoming that the world expect the light

to shine indefinitely when carrying a lantern is often less remunerative than carrying a hod. The money and the years of study required for special training are not recognized as invested capital, and the return from a decade of research is often taxed as the income of a year. Professorial salaries move forward as slowly as a glacier, but they seldom leave a terminal moraine. Yet teaching is our most important business, for a failure to pass on for a single generation the painfully accumulated knowledge of the race would return the world to barbarism.

Though material wealth is rarely acquired by the Fifth Estate, they have the riches of the royal man, defined by Emerson as " he who knows what sweets and virtues are in the ground, the waters, the plants, the heavens, and how to come at these enchantments." Their wealth is in the kingdom of the mind. It is inalienable and tax-exempt. It may be shared and yet retained.

A recent survey by a national magazine would seem to indicate that the majority of men have drifted into their vocations with little effort of selection and that a very large proportion ultimately regret their choice. This is seldom true of members of the Fifth Estate. Theirs is a true vocation, a calling and election. It brings intellectual satisfactions more precious than fine gold. They live in a world where common things assume a beauty and a meaning veiled from other eyes; a world where revelation follows skillful questioning and where wonder grows with knowledge. Together they share the interests, the communion of spirit, the labors and the triumphs of the fraternity of science. The law of diminishing returns exerts a control from which there is no escape in agriculture, industry and business. Research alone is beyond the twelve-mile limit of its inhibitions.

If "the Heavens declare the glory of God" that glory is surely made more manifest by telescope and spectroscope. If the whirling nebulae and the stars in their courses reveal omnipotence, so do the electrons in their orbits reveal His presence in universes brought into being by the striking of a match. The laboratory may be a temple as truly as the church. The laws of nature are the will of God, their discovery is a revelation as valid as that of Sinai, and by their observance only can man hope to come into harmony with the universe and with himself.

There has been a general and ready acceptance by the world of the material benefits of science, while its contributions to sociology and ethics are as generally ignored as guides to human conduct. Yet science proclaims new commandments as inflexible as those engraved on stone and furnishes what Wiggam has reverently termed "the true technology of the will of God."

Science has so drawn the world together and so rapidly remoulded civilization that the social structure is now strained at many points. Statecraft and politics, law and custom lack the plasticity of science and are now in imperfect contact with the contours of their new environment. The result, as events have shown, is friction and confusion. Though our civilization is based on science, the scientific method has little place in the making of our laws. Office does not seek the man in the laboratory, and candidates are not pictured as engaged in any activity that might suggest a superior intelligence. They are shown milking cows, pitching hay in new blue overalls, or helping with the family washing. Recently, in the senate of a New England state, there was presented the edifying spectacle of the presiding officer, being shaved by a barber, called to the rostrum, while senators were reading the encyclopaedia into the record. To expedite further the public business sundry members of the chamber were presently gassed with bromine. Does not this suggest that a few chemists might with advantage be distributed among our legislative bodies?

It is claimed that fifty per cent. of the members of state legislatures in America have never been through high school and that only one in seven has been through college. We see in the ranks of science knowledge without power and in politics power without knowledge. An electorate, which regards itself as free, listens to the broadcasted noise of manufactured demonstrations and is blind to the obvious mechanics of synthetic bedlam. The result is too often government by gullibility, propaganda, catchwords and slogans, instead of government by law based on facts, principles, intelligence and good will.

As President Stanley Hall once said, "man has not yet demonstrated that he can remain permanently civilized." Many thoughtful people have been led to question the ultimate effect of science upon civilization. We all recognize the utility of matches, but we keep them away from children. Meanwhile, science puts dynamite and T.N.T., poison gas, aeroplanes and motor cars at the disposal of criminals and the leaders of the mob. B. Russell, in "Icarus," sees in science the ultimate destroyer. Haldane, in "Daedalus," visualizes it as the stern and vigorous chastener and corrector which will ultimately save the race and usher in the new day of light and reason.

"Knowledge comes but wisdom lingers," and democracy levels down as well as up. Even in Boston cigars have replaced books on a corner famous for a century of literary associations. The world is wrong because few men can think. It will not be made right until those who can not think trust those who can. When its foundations are so obviously out of joint humanity still clings tenaciously to fossilized

precepts and opinions and is as resentful of suggested change as in the days of Galileo. Despite the pressure of new ideas, education must still, to be acceptable, follow old conventional lines.

Though we go from here to happy homes, let us not deceive ourselves. Human life is still a hard and fearsome thing. Mankind is required to maintain existence in a world in which, as Kipling has said, "any horror is credible." More than a hundred years ago De Quincey wrote, "We can die, but which of us, knowing as some of us do, what is human life, could, were he consciously called upon to do it, face, without shuddering, the hour of birth." But little more than yesterday Henry Adams closed his "Education" with the expression of the hope that perhaps some day, for the first time since man began his education among the carnivores, he would find a world that sensitive and timid natures could regard without a shudder.

Everywhere there is upheaval and unrest. "The machine," to quote Dr. Elton Mayo, "runs to an accompaniment of human reverie, human pessimism and sense of defeat."

We are everywhere overburdened by unnecessary illness, crushing taxation, extravagant and inefficient governments, huge expenditures for trivialities and the appalling waste of effort, material and resources. We are hampered by class suspicion and misunderstanding, racial antagonisms, the inhibitions of organized labor and the lack of imagination in high places. Life in general is on a low cultural plane and bound by custom and tradition.

One hundred years of science have failed to satisfy the cravings of humanity. Chesterton finds science "a thing on the outskirts of human life—it has nothing to do with the center of human life at all." We do not, of course, agree with him, but we must still meet the challenge of John Jay Chapman, who declares: "Science, which filled the air with so large a bray, is really a branch of domestic convenience, a department for the study of traction, cookery and wiring. The prophet-scientists have lived up to none of their prospectuses." The fault, however, as Wiggam points out, is not with science, nor with the scientists. It is with those who "have mainly used the immense spiritual enterprise of science to secure 5-cent fares, high wages and low freight rates," when it should have "ushered in a new humanism."

Thus we still encourage race-deterioration, still carry the burden of the unfit, still cultivate national antipathies, still are breeding from poor stock, and witnessing with equanimity the suppression of the best.

The history of aristocracies, feudalism, the church, the guilds and the soviets has amply demonstrated that no one class possesses the qualities required for the government of all classes, and we can not claim them for the Fifth Estate. We can, however, claim with full assurance that the Fifth Estate possesses many qualities, now practically ignored, which could be utilized in government to the incalculable advantage of us all. Its knowledge of material facts, of natural and economic laws, of the factors governing race development and human relations; its imagination, vision and its open mind should be brought to bear effectively in the formulation of national policies and the solution of governmental problems. There is an alternative before us, which has recently been defined with somewhat surprising frankness by Warren S. Stone, president of the Brotherhood of Locomotive Engineers, perhaps the most conservative of the labor unions. Mr. Stone says:

> But until labor, in the inclusive sense in which I am using it, secures control of legislative and executive branches of the national and state governments, and through control of the executive branch secures control of the judiciary, labor is in continuous peril of seeing its gains wiped out and its progress retarded, by hostile legislation or unfriendly court decisions.

Our countrymen may well consider whether they prefer participation in government by the Fifth Estate to the benefit of all or control of government by labor unions in the interest of labor.

Since most of the troubles that beset mankind have their origin in human nature it would seem worth the while of those who make our laws to study and apply the findings of the biologists and psychologists as to what human nature really is and the springs of its motivation.

Plato called democracy "the best form of bad government." It will be the best form of good government only as it develops the capacity to breed leaders and the faith to trust them. The quality of our children will determine the quality of our democracy. If our laws and mores and economic structure continue to discourage breeding from our best strains, if there is to be no adequate recompense for service of the higher types, the time is not far distant when democracy will no longer be safe for the world. If the Fifth Estate were everywhere to be wiped out, as it has been in Russia, the result would be vastly more calamitous than universal war.

Oswald Spengler, in a recent monumental work, forecasts the downfall of western civilization and would prove his thesis by the history of past cultures. But never in the past has man lived in so compact a world, never has he had such facilities for intercommunication with his fellows, never has he been endowed with such control of natural forces. He has

never known himself so well and, above all, never before has he had it in his power to direct so definitely the course of his own development. Our civilization is certainly imperiled, but there will be no downfall if mankind can be taught to follow the light already before it. As lantern bearers, it is the clear duty of the Fifth Estate to show the way. In the past the world has suffered grievously from lack of knowledge; to-day it suffers from its rejection or misapplication. Could the springs of human conduct and the affairs of peoples now be regulated only as wisely as we now know how there would be work and leisure and decent living for all. The criminal, the defective, the feeble-minded would be breeded out, and sane minds in sound bodies breeded in. The loss and suffering from preventable disease and accident would not be tolerated. Higher standards would govern the selection for the public service. Planning would replace *laissez-faire* development, and a rational conservation check the reckless waste of our resources. Production and distribution would attain to levels of efficiency altogether new, and the many injustices now existent in human relations would well-nigh disappear. With the reaction of a freed intelligence on politics, religion, morals we might hope for a broader tolerance, a better mutual understanding. With the recognition of the spirituality of science and the divinity of research and discovery should come larger interests and a new breadth of vision to the average man, and to us all acknowledgment of the steadfast purposive striving shown in the development of the created world and a reverent appreciation of man's privilege to aid and further this development.

We might reasonably expect ugliness to be replaced by beauty in our cities and small towns and later even in our homes. Government by intelligence for the general good of all should supersede government by special interests, blocs, faddists and fear of organized minorities and the uninformed crowd. With it all would come relief from the economic pressure, which bears so heavily upon the Fifth Estate that its children, which should be counted among the best assets of the community, are now a luxury.

The world needs most a new tolerance, a new understanding, an appreciation of the knowledge now at hand. For these it can look nowhere with such confidence as to the members of the Fifth Estate. Let us, therefore, recognize the obligation we are under. Ours is the duty and the privilege of bringing home to every man the wonders, the significance and the underlying harmony of the world in which we live.

Arthur D. Little

JOHN MACLEAN—CHEMIST[1]

John Maclean, M.D., the first professor of chemistry in the College of New Jersey (Princeton) and, according to Dr. Edgar F. Smith, one of the first chemists in the country at the close of the 18th century, was born in Glasgow, March 1, 1771, which made him a contemporary of Davy, Dalton, Priestley, Lavoisier, Berzelius, Avogadro and other very eminent chemists. His father, for whom he was named, was a surgeon of note, who was present at the capture of Quebec from the French, and he was the third man to scale the formidable heights of Abraham. His mother was Agnes Lang, of Glasgow.

While very young he lost both of his parents, whereupon George Macintosh, a gentleman of rare worth, became his guardian. It is of interest to note that he was the father of Charles Macintosh, F.R.S., a wealthy chemical manufacturer who invented the water-proof cloth.

Young Maclean received his early education at the Glasgow Grammar School and in the university, which he entered before he was 13 years of age, thus indicating that he was a precocious lad. This is borne out by the fact that he was awarded several premiums in school and in the university. It appears that he was much interested in the classics, particularly Latin, and in later years he wrote to his son, John Maclean, Jr., who became the tenth president of Princeton, as follows: "Be assured, that notwithstanding what ignorant and lazy people say, it is a matter of great consequence for every gentleman or professional man to be a good classical scholar."

At the university it is said that he gave close attention to chemistry, mathematics and natural philosophy, and especially to chemistry. In the 16th year of his age he joined the Chemical Society of Glasgow, before which he read at least seven papers, including one on *respiration*, another on *fermentation* and another on *alkalies*. Some of these papers contained suggestions in advance of the science of that day.

While at Glasgow Dr. Maclean also studied medicine and anatomy, for it was his purpose to become a surgeon. From Glasgow he went to Edinburgh, primarily, it may be presumed, to attend the chemical lectures of the celebrated Dr. Black. From Edinburgh he repaired to London and to Paris, where he had the best facilities for the study of chemistry and surgery. While a student at Paris, Lavoisier, Berthollet and other famous chemists were busy with their investigations, and Maclean was no doubt greatly impressed by them.

[1] A paper read before the Section of History of Chemistry at the 67th Meeting of the American Chemical Society, Washington, D. C., April 21 to 26, 1924.

After being absent from Glasgow about three years (1787–1790), he returned and resumed his studies for another year, and then engaged most successfully in the practice of his profession, continuing at the same time his researches in chemistry. In the 21st year of his age he became a member of the Faculty of Physicians and Surgeons of Glasgow University.

Being thoroughly in sympathy with the political sentiments of America, Dr. Maclean left Scotland in April, 1795, and arrived at New York the following month. From this city he went to Philadelphia, where he met Dr. Benjamin Rush, who advised him to go to Princeton. Acting upon this suggestion, he formed in Princeton a partnership with Dr. Ebenezer Stockton for the practice of physic and surgery. This partnership was soon dissolved, however, for Dr. Maclean was elected to a chair of chemistry in the College of New Jersey and he soon decided to devote his entire time to teaching.

It is of further interest to note that Dr. Maclean came to America the year after Priestley—the same year in which Lavoisier was beheaded. This was before Dalton and Avogadro had propounded their hypotheses, before Gay-Lussac had enunciated the law of gaseous volumes, and years before Berzelius introduced modern chemical symbols.

In the early summer of 1795, Dr. Maclean delivered in Nassau Hall a short course of lectures on chemistry, which made a favorable impression. On October 1, 1795, he was elected professor of chemistry and natural history; but the name of the chair was subsequently changed to "mathematics, natural philosophy and chemistry."

In 1797 his salary was 250 pounds ($666.66) per annum; and it was "ordered that chemistry and natural history be taught as branches of natural philosophy." The instruction in these branches was given only to juniors and seniors. Dr. Maclean taught at Princeton until 1812, and for several years his salary was $1,250 a year, together with the use of a college house.

Benjamin Silliman, M.D., the first professor of chemistry in Yale College, left in his diary the following statement:

> At this celebrated seat of learning (Princeton), an eminent gentleman, Dr. John Maclean, resided as professor of chemistry, etc. I early attained an introduction to him by correspondence, and he favored me with a list of books for the promotion of my studies. . . . I also passed a few days with Dr. Maclean in my different travels to and from Philadelphia, and obtained from him a general insight into my future occupation; inspected his library and apparatus, and obtained his advice respecting many things. Dr. Maclean was a man of brilliant mind, with all the acuteness of his native Scotland; and a sparkling wit gave variety to his conversation. I regard him as my earliest master in chemistry and Princeton as my starting point in that pursuit: although I had not an opportunity to attend lectures there.

Many years later Dr. Silliman revisited Princeton, and he said to President Maclean upon visiting the chemical laboratory: "It was in this room that I saw the first experiments in chemistry ever witnessed by me."

The younger Professor Silliman, of Yale, in a paper entitled "American contributions to chemistry," and read July 31, 1874, on the occasion of the Priestley Centennial, said: "Of the public seminaries of learning other than medical institutions where chemistry was taught from a separate chair, and as a distinct branch of the college curriculum of instruction prior to 1800, we find but one, and that distinction belongs to Nassau Hall, Princeton, New Jersey."

It should be stated in this connection, however, that James Hutchinson and Dr. James Woodhouse of the University of Pennsylvania, Aaron Dexter of Harvard, and Dr. Samuel Mitchell of Columbia were contemporaries of Maclean, and taught more or less chemistry at a very early date in those institutions; but the speaker is unable to state just when chemistry was taught in those institutions "from a separate chair, and as a distinct branch of the college curriculum." From Dr. Silliman's paper just referred to, I also beg to quote as follows:

> Dr. Maclean ever deserves honorable mention as one of the earliest and most successful teachers of our science in this country. . . . In Paris Dr. Maclean learned to admire the antiphlogistic theory, as the "new chemistry" of Lavoisier was called, and which he taught and defended at Princeton. In 1795 he published "Two lectures on chemistry, read at Nassau Hall, containing an examination of Dr. Priestley's consideration on the doctrine of phlogiston and the decomposition of water." These lectures display both ability and learning and form an interesting chapter in the history of phlogistic discussion.
>
> Dr. Maclean contributed several articles to the New York *Medical Repository*, and his name is associated with that of Professor Silliman in editing the first American edition of Henry's "Chemistry," in 1808.

The speaker has been fortunate enough to find in the Library of Princeton University a notebook on chemistry by John Eager Howard, Jr.,[2] of Baltimore, bearing the date of 1806. Howard was a pupil of Dr. Maclean, and his notes are very full and beautifully written. Apparently they are a transcript of Dr. Maclean's lectures. In these notes we find the topics

[2] John Eager Howard, Jr., was a son of General John Eager Howard, and a grandson of Justice Chew. He graduated at Princeton in 1806 and was at one time a member of Congress.

discussed by the lecturer. The following statements are taken from this notebook:

Chemistry is the investigation of those intimate and mutual actions of bodies on each other, by which their properties are altered, or their individuality destroyed. . . .

Matter may be divided into dead and living. Of dead substances some are simple and others compound. The simple are those whose composition is unknown, and the compound are such as have been analyzed into simpler parts. The substances which, according to the above definitions, may be considered as simple are:

caloric	silex	fluoric acid	antimony
light	alumine	boracic acid	mercury
electricity	magnesia	arsenic	zinc
oxygene	lime	tungstein	tin
azote	barytes	cobalt	lead
hydrogene	strontites	malybdena	copper
sulphur	pot-ash	bismuth	silver
phosphorus	soda	nickel	gold
carbone	muriatic acid	manganese	platina

There are 37 of these "simple substances," which constitute the titles of so many chapters in the notebook. 17 of these were regarded as metals, which were divided into semi-metals (brittle) and metals.

Dr. Maclean also gave a second course in chemistry, which had to do with *living* or *animated bodies*. This was a much shorter course, dealing with the structure and organization of vegetables, vegetable productions, fixed gross or fat oils, volatile oils, the composition of vegetables and tanning and currying.

It thus appears that Dr. Maclean gave attention to the relation of chemistry to agriculture and manufactures as well as to medicine.

Finally, Dr. Maclean resigned at Princeton in 1812 to accept the chair of chemistry in William and Mary College. He spent a year at Williamsburgh; but, being in poor health, he returned to Princeton at the close of the college year, where he died February 17, 1814, and two days later he was buried in the so-called "Westminster Abbey of America," his grave being contiguous to those of the college presidents and professors, and where all who still come and go may read the following extract taken from the Latin inscription on his tomb: "Exceedingly beloved and esteemed by the professors and youth of the college, he departed this life lamented by all."

WILLIAM FOSTER

PRINCETON UNIVERSITY

GEOLOGICAL FEATURES OF CITY PARKS

As a result of the request of the Committee on the Features of City Parks appointed by the American Association for the Advancement of Science a little over a year ago the following announcement was made March 26, 1924:

From 35 writers encouraging reports were received. Most of them stated that a beginning had been made in the way of conferences; a few told that work had been begun; two, Pittsburgh, Pennsylvania, and St. Joseph, Missouri, reported good progress; and Hartford, Connecticut, announced a completed task, in the way of selecting, clearing and marking a good number of geological features in that city.

Because Hartford and Trinity College were the first to report work completed along the lines suggested by the committee, Professor Davis, its chairman, has asked me to make a statement concerning our endeavors.

At the time of the 1923 centennial celebration of Trinity College there was published a special number of the *Trinity College Bulletin*, setting forth in description, photographs and diagrams the principal features of the rocks of the campus and the adjacent Rocky Ridge Park. Although this was not precisely what the committee wanted (except for some excavating which had been done to expose glacial grooves) yet the work in preparing the bulletin furnished the happy background, and it was an easy matter and a next logical step forward to place signs here and there to designate the chief features which had been observed.

Ten signs were put on the campus and in the park. Three of them were large printed labels, under glass, located near the entrances or at other especially important positions and each shows a diagram of the whole area with the locations of all the stations, a main text or summary of the general geological features, on one side three block diagrams representing the structure in its stages of development and on the other a description and photograph of the particular feature which the sign is intended to explain.

In addition to the large signs there are seven small ones each with a brief inscription painted on wood: one calls attention to some "grooves at your feet made 100,000 years ago by the glacier," another is near a huge glacial boulder, another marks the contact between the trap rock and sandstone, and so on for the seven.

So far as the classes in geology are concerned the rocks of the campus and park have furnished us a veritable museum and laboratory for the study of earth phenomena. The structure is well shown and is typical of the whole Connecticut Valley. Besides the major rift represented by the Rocky Ridge itself, so well known to geologists, there is a small clear-cut fault with a throw of about four feet; the fault zone presents slickensides, breccia and dragging; the fault surface is marked by a thick vein of white barite with a half dozen other minerals. The red sandstone and trap rocks have much of interest; the physiographic features illustrate many of the prin-

ciples we are studying in our courses; there is abundant evidence of glaciation.

The signs have helped in the instruction of the scientific students, but evidently they had a wider need.

From the standpoint of the people of the city who chance to pass through the park the signs have been a revelation; they have made the cliffs something more than the barrier to their progress across the city. Several letters have come in expressing delight at the offer of a solution to the "riddle of the rocks," and the simple explanation of what had generally been ascribed in a vague way to "an upheaval of some sort."

It was gratifying indeed to see the enthusiasm, almost eagerness, with which the city and college authorities took up the task and carried it through. Great credit is due President Ogilby of Trinity College, Professor Perkins, commissioner for Rocky Ridge Park, and Mr. Parker, chairman of the city park board.

EDWARD L. TROXELL

TRINITY COLLEGE,
HARTFORD, CONNECTICUT

SCIENTIFIC EVENTS

THE ORGANIZATION OF TEACHING IN THE UNIVERSITY OF CAMBRIDGE[1]

THE University Commissioners appointed in accordance with the recommendations of the Royal Commission regarding the organization of teaching in the University of Cambridge have, after considering the representations made to them, sent a memorandum to the vice-chancellor embodying the following scheme:

Faculties.—Under the scheme, which it is proposed to bring into force on October 1, 1926, there would be faculties, faculty boards and a general board of studies. All fees for lectures announced by the general board of studies would be paid to the university.

There would be eighteen faculties, arranged in two groups—arts and science. In the arts group there would be eleven faculties and in the science group seven. In the latter, however, the faculty of biological studies would be divided into two departments, the one containing four sections and the other six. The departments in the second section of the faculty of biological studies would be biochemistry, experimental psychology, human anatomy, parasitology, pathology and physiology. The faculties would be composed of professors, readers, university lecturers, fellows of colleges giving lectures or demonstrations and a certain proportion of other persons appointed by the board of the faculty.

Medicine would be one of the faculties in the science group. It would consist of teachers who come within one of the classes above mentioned, and give instruction in medicine, surgery, pharmacology, anatomy, biochemistry, physiology or pathology, or give courses in physics, chemistry or biology for medical students.

The faculty boards would consist of the professors, a certain number of members of the faculty elected by it for a period of four years, a certain number of persons nominated by the council of the senate for a period of two years, a certain number nominated by the board, and in certain cases representatives of cognate studies.

The Faculty Board of Medicine would consist of the Regius professor of physics, the Downing professor of medicine, the professors of anatomy, biochemistry, pathology and physiology, four members of the faculty elected by it, and two persons nominated by the council.

General Board of Studies.—The suggestion of the commissioners is that the general board of studies should consist of the vice-chancellor, of four members each of the groups of arts and science faculties, respectively, four members of the council of the senate and two persons not members of the council of the senate elected by the university for four years. It is proposed to transfer the present duties of the general board in regard to the awarding of the higher degrees to the board of research studies.

University Lectureships.—The commissioners suggest certain regulations for university lectureships (including demonstratorships). Lecturers would be appointed by a standing committee separately constituted for the faculty or department. This committee would consist of the vice-chancellor, the head of the department, three members of the board of the faculty and two persons nominated by the general board.

Tenure.—Appointments would, as a rule, be made in the first place for three years, but on reappointment tenure would be for so long as the lecturer continued satisfactorily to perform the duties of his office until the retiring age. The faculty board is to ensure that professors, readers and lecturers continue to perform the duties of their office satisfactorily.

Work and Salaries.—The passage from the report under this head is as follows: "The Commissioners think it will be impossible to ensure absolute equality between the conditions of work and remuneration in the various faculties. Their present opinion is that there should be a basic amount of teaching work obligatory upon a university lecturer—namely, not fewer than thirty-two or more than forty-eight hours of lecturing during the year. That the initial basic salary given in respect of such amount of work be not less than £160. That the general board should have authority to vary in specific cases the requirements as to the basic amount of teaching work. That each faculty should have a scale of increments in the basic salary to be approved by the general board, and that other payments in addition to the basic salary should be made in consideration of work done in addition to the basic amount of work. That boards of faculties should have power to make a maximum additional payment of £250 a year to a university lecturer who is not a fellow of a college. That the payments to be made to university lecturers in addition to the basic salary should be deter-

[1] From the *British Medical Journal.*

mined by the faculty board concerned and made from faculty or departmental funds. These funds will consist of (1) fees for lectures, including lectures given by professors and readers, (2) contributions from the chest."

Retiring Age.—The commissioners recommend that the retiring age for all members of the university teaching and administrative staffs shall be 65, but contemplate that the general board would have power to continue a professor in office for a period not exceeding five years—that is, until he attains the age of 70.

Position of Women in Relation to Teaching.—The commissioners contemplate that the statutes will be so framed as to render women eligible for professorships, readerships, university lectureships and examinerships, subject to the reservations made by the Royal Commission. Fellows of women's colleges will be eligible to become members of faculties.

CANADA'S WATER POWER AND MINING INDUSTRIES

A BULLETIN has been issued by the water power branch of the Canadian government on the effect of the plentiful water power on the future developments of the mining industry which states that the theory is often advanced that Canada is likely to become the leading mineral-producing country of the world, and considerable ground for this assumption is found in the fact that the Dominion contains 16 per cent. of the world's known coal resources, has greater asbestos, nickel and cobalt deposits than any other country and ranks third in the production of gold, while the diversity of her mineral endowment is indicated by the fact that the three main divisions—metallic, non-metallic and structural and clay products—include some sixty principal items, seventeen of which had a production value of $1,000,000 or over for each in 1923.

The best conception of the value of the output may be given by stating that the lowest since 1910 was $103,221,000 for 1911, and the highest was in 1920, when the valuation of $227,860,000 was reached, the average value being $194,957,000 for the five-year period. As the commodity prices reached a peak in 1920, and have since receded, production computed in terms of value is not a fair basis for comparison. An index showing the volume of production by weight would undoubtedly mark 1923 as the banner year in Canada's mineral industry, since new output records were established last year for coal, lead, zinc, asbestos and for the value of cobalt produced.

The principal uses of power in mining are for compressed air for drilling, driving motors for hoisting, haulage of ore above and below ground, driving ore crushers and conveyers, pumping water for the water supply and removing it when it accumulates below ground, lighting, heating, ventilating, signaling, for machine shops and for various electrical-metallurgical processes. Even in the comparatively simple method employed in the recovery of coal as much as 10 per cent. of the product may be consumed in generating the necessary power.

The bulletin states that the Dominion Water Power Branch has computed that on January 1 last the hydraulic installation for mining purpose in the Dominion had reached a total of 277,600 horsepower, of which 233,200 horsepower was purchased from central electric stations. It is estimated that the capital investment necessary to develop this power was £74,000,000.

From the point of view of minerals and the development of mining Canada is divided into five main areas, which consist of the Maritime Provinces, Quebec, Ontario, the Prairie Provinces and British Columbia and the Yukon. Each of these possesses large resources for water power, already developed or available. With the exception of some of the coal fields of the central plain there is no area for which ample water power can not be supplied.

The department's latest table of available and developed water power in Canada, dated February 1, shows there is a total available twenty-four-hour power, at 80 per cent. efficiency, of 18,225,316 horsepower at ordinary minimum flow and 32,075,998 horsepower at ordinary six months flow, and a total turbine installation in Canada of 3,227,414 horsepower. The table shows the fortunate distribution of water power throughout the Dominion. The two provinces without native coal, Ontario and Quebec, lead in the possession and utilization of water power, followed closely by Manitoba, where only lignite coal is found.

LOWELL INSTITUTE LECTURES FOR 1924–25

NINE courses of free public lectures treating upon diverse subjects, including politics, history, meteorology, geology and science, are announced by the Lowell Institute of Boston, for the season which will begin about the middle of October and continue through March.

Of the lecturers four are from Harvard, one from Princeton and four from England. The British visitors are to be Rt. Hon. Herbert Fisher, M.P., former minister of education and British delegate to the first three assemblies of the League of Nations, who will speak on "The aftermath of war"; Dr. A. J. Carlysle, of Oxford, on "The medieval political theory and the principles of modern political organization"; General Sir Frederick Maurice on "Robert Lee, the soldier," and Professor William George Stewart Adams, of Oxford University, on "Idealism and realism in politics." Dr. Dana Carleton Munro, pro-

fessor of medieval history at Princeton University, has taken for his subject, "The Latin Kingdom of Jerusalem," and will trace its development and decline in eight lectures. Dr. Alexander McAdie, professor of meteorology at Harvard and director of the Blue Hill Observatory, is to speak on "The weather in peace and in war." Another Harvard man, Dr. Reginald A. Daly, chairman of the department of geology and geography, will follow Dr. McAdie with a course on "Our mobile earth." The other two lecturers from Harvard are Dr. Alfred North Whitehead, professor of philosophy, whose eight lectures will be on "Science of the modern world," and Dr. Walter Fenno Dearborn, professor of education, who will discuss in eight lectures "Intelligence tests, their significance and implications."

The subjects of the lectures by Dr. McAdie, Dr. Daly and Dr. Whitehead are as follows:

Our Mobile Earth

A course of eight lectures by Reginald A. Daly, Ph.D., S.D., chairman of the Department of Geology and Geography, Harvard University, to be given Mondays and Thursdays at eight o'clock in the evening, beginning Monday, January 5.

1.—Great earthquakes of history.
2.—Seismology, the science of earthquakes.
3.—Nature of the earth's interior.
4.—Mechanism of volcanic action.
5.—Distortion of the earth. Warping of the continents. Distribution of land and sea in past time.
6.—Mountain ranges. Location, kinds, ages.
7.—Mountain ranges. Origin of structure and form.
8.—Evolution of the face of the earth.

The Weather in Peace and War

A course of six lectures by Dr. Alexander McAdie, A. Lawrence Rotch professor of meteorology in Harvard University and director of the Blue Hill Observatory, to be given Mondays and Thursdays at eight o'clock in the evening, beginning Monday, December 1.

1.—Present knowledge of the atmosphere, especially results of recent soundings.
2.—Clouds and water vapor in the free air.
3.—Lightning and other manifestations of atmospheric electricity.
4.—Droughts, floods and seasonal forecasts.
5.—The strategy of weather in war.
6.—Aerography in the arts and sciences.

Science and the Modern World

A course of eight lectures by Dr. Alfred North Whitehead, professor of philosophy in Harvard University, to be given on Mondays and Thursdays at five o'clock in the afternoon, beginning Monday, February 2.

1.—Science and modern civilization. Birth of modern science. Classical and medieval antecedents. Evolution of the scientific mentality from medieval law, theology and art.
2.—Science of the seventeenth century. Galileo to Newton. Bacon, Descartes, Leibnitz. Man and nature. The fundamental generalizations.
3.—The eighteenth century and the "victorious analysis." Triumph of Newtonian dynamics. Materialism and empiricism. Prevalence of Greco-Roman influence over that of earlier Greek thought. Rational despots and aristocracies.
4.—Science and literature. Pope, Wadsworth, Shelley, Tolstoy, Ibsen, Bernard Shaw. Science and the Greek conception of fate.
5.—Civilization and technology. Energy, its conservation and utilization. Sociology and speed. Biology and racial development. From picture-writing to broadcasting. Instrumental design. The nineteenth century.
6.—Modern thought. Collapse of the eighteenth century settlement. From matter to electricity. Continuity and atomism. Relativity. Hypotheses.
7.—Science, religion and philosophy. From Locke to Bergson. From Galileo to Darwin. The eternal and the transitory. Tradition and progress.
8.—Science and education. The places of logic, science, literature, art, knowledge, enjoyment, genius, patriotism and world-citizenship.

THE MILTON FUND FOR RESEARCH OF HARVARD UNIVERSITY

PRESIDENT A. LAWRENCE LOWELL, of Harvard University, has made the following statement regarding the bequest left by the late William F. Milton:

The late William F. Milton left the bulk of his estate to his wife for life, and after her death to Harvard University for the purpose, first, of building a library if the university had no suitable library building, and then "If said fund is not used in constructing and erecting such library building, or if a part thereof remains after such construction, I then hereby authorize and empower said President and Fellows of Harvard College to use the *income* of said fund, or such *income* thereof as remains after constructing said library building, from time to time, either in whole or in part, to defray the expenses of any special investigation of a medical, geographical, historical or scientific nature which said Corporation may from time to time desire to make or prosecute in the interests of, or for promoting the physical and material welfare and prosperity of the human race, or to assist in the discovery and perfecting of any special means of alleviating or curing human disease, or to investigate and determine the value or importance of any discovery or invention, or for any other special or temporary object of the nature above stated. . . ." The legacy has now been received by the university, and is expected to yield an income of about $50,000. The provisional arrangement for its use in the immediate future is as follows:

The Corporation will be glad to receive from any member of the instructing or scientific or administrative staff of the university requests for aid in investigation. Such requests must be received before December 1 next, and must specify the object and nature of the investigation with as much precision as is necessary to judge of its value, the probable length of time it will require, and the expense involved; this last item to include the salary for the proportion of time to be transferred from other duties. The Corporation will appoint each year a committee to advise it in making a selection among the investigations proposed, and in the allotment of income therefor. No allotments will be made for more than two years; but if an investigation proves to require a longer period, the grant may be renewed.

SCIENTIFIC NOTES AND NEWS

THE centennial celebration of the Rensselaer Polytechnic Institute opens at Troy, New York, on October 3. The program, printed in SCIENCE for August 29, contains the names of a large number of official delegates from educational institutions, scientific organizations and engineering societies throughout the world, including the following from abroad who will give addresses: President Sir Charles Langbridge Morgan, of the Institute of Civil Engineers of Great Britain; President Henri Abraham, of the Society of Electrical Engineers of France; President Luigi Luiggi, of the Society of Civil Engineers of Italy; Honorary President Roberto Gayol, of the Society of Engineers of Mexico; President Arthur Surveyer, of the Engineering Institute of Canada.

EXERCISES formally inaugurating the Boyce Thompson Institute of Plant Research at Yonkers, New York, took place on September 24 with Dr. John M. Coulter, professor of botany at the University of Chicago, presiding.

DR. HARVEY CUSHING, professor of surgery at the Harvard Medical School and surgeon-in-chief of the Peter Bent Brigham Hospital, Boston, will deliver the dedication address at the opening of the new school of medicine of Western Reserve University on October 9.

DR. S. P. L. SÖRENSEN, of the Carlsberg Laboratories, Copenhagen, Denmark, lectures before the first regular meeting of the New York Section of the American Chemical Society on the evening of October 3, his subject being "The heat of coagulation of proteins." On the following evening, October 4, Professor Sörensen will deliver the first Harvey Society Lecture at the New York Academy of Medicine, on "The solubility of proteins."

THE recent award by the Paris Academy of Sciences of le prix Saintour to Lee deForest was made with the following citation: "inventeur de la lampe a trois electrodes pour les perfectionnements apportés par lui dans la technique des ondes hertziennes qui ont rendu possible la telephonie sans fil."

DR. KOTARO HUNDA, of the Imperial University, Japan, was made an honorary member of the American Society of Steel Treating at the recent meeting in Boston.

PRESIDENT LUIGI LUIGGI, of the Society of Civil Engineers of Italy, who is visiting the United States on the invitation of the Rensselaer Institute of Technology, was the guest of honor at a luncheon, given by the Italy-American Society at the Bankers' Club, New York City, on September 24.

DR. CHARLES TODD, technical expert to the Egyptian Department of Public Health, has had conferred upon him the insignia of the Second Class of the Order of the Nile by the King of Egypt in recognition of valuable services rendered.

ADDITIONS to the Harvard Observatory include Dr. Georges Lemaitre, of the University of Louvain, Belgium, who will join the staff for a year. Professor B. Gerasimovic, senior observer at the university observatory of Kharkow, Ukraine, will spend some months at the observatory on astrophysical investigations, and Paul Davidovich, of Turkestan and Moscow, also will be at the observatory for part of the year to make investigations.

PROFESSOR DONALD BRUCE has resigned from the University of California to accept the position of chief of forest mensuration with the Forest Service at Washington, D. C.

THE Cushman fellowship in Western Reserve University, recently founded through a gift from the Ferro Enameling Co., has been awarded to Howard Williams, of Ohio.

DR. OTTO HAHN, member of the Kaiser-Wilhelm Institute of Chemistry, has been appointed director of the institute.

THE eighty-fifth birthday of Professor B. Naunyn was celebrated recently. He is still continuing his research on diabetes and gallstones, although he retired from academic work in 1904. He is soon to publish a volume of reminiscences.

DR. OSCAR BREFELD, professor of botany at the University of Breslau and known for his work on mushrooms, has celebrated his eighty-fifth birthday.

DR. A. B. COX, agricultural economist of the Department of Agriculture, is leaving for a year's study in England, Germany, France and Italy of cotton marketing methods, supply, demand and prices.

SIR WILLIAM JONES, chairman of the research committee of the British Refractories Association, is now on a visit to the United States.

DR. JEANNENEY, of Bordeaux, France, is visiting the United States for the purpose of studying our methods of dealing with the cancer problem.

CAPTAIN RASMUSSEN, the explorer, has left Nome in the schooner *Teddy Bear* to study the Siberian Eskimo tribes. Having visited all the Eskimos from Greenland to Nome he desires to complete his observations by visiting the Siberian tribes.

DR. M. A. CHRYSLER, of the department of botany of Rutgers University, spent part of August and September in western Cuba and southern Florida. The endemic Cuban cycad *Microcycas* was the particular object of search.

SIR JOHN RUSSELL, director of the Rothamsted Experimental Station, England, gave the Hitchcock lectures for the season of 1924–25 at the University of California. His subjects were: "The discovery of the food of plants." "Modern problems in plant growth: can science solve them?" "Decay and the living plant, 'Mors juana vitae.'" "The soil organisms: can they be controlled and utilized?" "The soil and the growing plant."

JULIAN S. HUXLEY, of Oxford University, will give a course of six lectures on some aspects of evolutionary biology at the New School for Social Research, New York, from October 8 to 24.

DR. EDMUND OTIS HOVEY, curator of the department of geology and invertebrate paleontology of the American Museum of Natural History, long secretary of the American Geological Society, died on September 26, aged sixty-two years.

DR. JOHN LORENZO HEFFRON, dean emeritus of the College of Medicine of Syracuse University, died on September 28, as the result of injuries received in an automobile accident. Dr. Heffron was seventy-three years old.

BERNARD H. RAWL, former assistant chief of the Dairy Division of the United States Department of Agriculture, died on September 23 at the age of forty-eight years.

DR. RANDOLPH BRYAN CARMICHAEL, professor of dermatology at the George Washington University Medical School, died on September 3, aged fifty-five years.

PROFESSOR KARL BRICK, member and scientific collaborator of the Hamburg Institute for Applied Botany, has died, aged sixty-two years.

THE following awards for 1924–25 have been made by the Salters' Institute of Industrial Chemistry, England: Fellowships are renewed to Dr. W. G. Sedgwick, Armstrong College, Newcastle-on-Tyne, and Oxford, Fellow, 1923–24, and to Mr. W. Randerson, Imperial College of Science and Technology, Fellow, 1922–23, and Hon. Fellow, 1923–24 (during tenure of Albert Kahn Travelling Fellowship). Fellowships are awarded to Mr. H. H. Evers, University of Liverpool; Mr. K. Knight Law, University College, Nottingham; Mr. H. S. Pink, University College, Nottingham, and Oxford, and Mr. V. E. Yarsley, Birmingham University. The Salters' Institute has also awarded 72 grants-in-aid to young men and women, employed in chemical works in and near London, to facilitate their further studies.

THE regular fall meeting of the Executive Committee of the American Association for the Advancement of Science will occur at the Cosmos Club in Washington on Sunday, October 12. Letters and memoranda concerning association matters to be brought before the committee should be in the hands of the permanent secretary not later than October 10.

THE eighteenth annual convention of the Illuminating Engineering Society will be held at Briarcliff Lodge, Briarcliff Manor, New York, from October 27 to 30.

AT the twenty-first annual meeting of the American Roentgen Ray Society held at Swampscott, Mass., from September 3 to 6, the following officers were elected for the ensuing year: *President,* Dr. George A. Groover, of Washington; *Secretary,* Dr. Charles L. Martin, of Dallas, Texas; *Treasurer,* Dr. W. A. Evans, of Detroit, reelected.

THE *Journal* of the American Medical Association reports that the Fifth Biology Reunion convened at the medical school in the City of Mexico on July 21, and continued for several days. Dr. Fernando Ocaranza, president of the Mexican Biological Society, opened the proceedings and spoke later on "Poisoning from scorpion stings" and "Mexican publications on physiology." Professor I. Ochoterena discussed neurologic questions, especially "The dual innervation of striped muscles," and Dr. I. González Guzman the "Technic of postvitam staining" and the "Differential blood count." Among the other speakers, Dr. T. G. Perrin described cancer of endocrine organs and Drs. Cervantes and Varela their experiences with testis implants.

OFFICERS elected at the eighteenth annual convention of the International Association of Game, Fish and Conservation Commissioners at Quebec are: J. Harkin, Ottawa, *president*; John S. Phillips, Pittsburgh, *first vice-president*; F. C. Walker, Hartford, Conn., *second vice-president*; R. P. Pollard, New York, *secretary-treasurer,* and Guy Amsler, Little Rock, Ark., *general manager.*

ARRANGEMENTS are being made for an International Congress of Radiology in London next summer. It is proposed that the congress shall be opened on

June 30, and continue for four days of two sessions each, and that visits shall afterwards be paid to provincial centers. The administrative and social center of the congress will be at the house of the British Institute of Radiology in Welbeck Street.

ACCORDING to the *British Medical Journal* the annual general meeting and conference of the Institute of Industrial Welfare Workers was held at Swanwick, Derbyshire, from September 26 to 29. The subject of the conference was "The doctor and the psychologist in industry." Dr. C. S. Myers, director of the Institute of Industrial Psychology, spoke on the subject of "What psychology can do for industry," and was followed by Dr. W. F. Dearden, honorary secretary of the Association of Certifying Factory Surgeons, who dealt with the subject of "What medical science can do for industry." "The psychological and physiological aspects of accident prevention" was discussed by Dr. Millais Culpin and Dr. H. M. Vernon, investigator for the Industrial Fatigue Research Board.

THE American Institute of Chemical Engineers has received an invitation from Sir Arthur Duckham, president of the Institution of Chemical Engineers (England), to hold a joint meeting in England in July, 1925, following the Providence meeting of the American organization. The secretary is now canvassing the members to see whether a sufficient number would attend a meeting in England to make a joint session successful.

DR. A. W. GILBERT, Massachusetts Commissioner of Agriculture, has announced plans for bringing together world leaders in all lines of agriculture at some American university next July, for a month's school of instruction and discussion of problems of cooperation in agriculture. Dr. Gilbert is chairman of the committee that will arrange for the meeting.

ITALY'S National Exhibition of Pure and Applied Chemistry, which was to have been held this fall at Turin, has been postponed until spring. It was found that the task of assembling the exhibits was greater than had been estimated. Because of the postponement, however, the scope of the exhibition will be expanded.

THE Iowa Child Welfare Research Station has received a bequest of $10,000 in the will of the late Cora B. Hillis, of Des Moines, Iowa.

THE establishment in Philadelphia of a technical research bureau to investigate the problems of dyeing, yarn testing, designing and other details of production has been approved at the annual convention of the National Knitted Outerwear Association.

THE University of Colorado has received a gift of $5,000 and an assured income of $1,000 a year for the purchase of books in medical research, from Mrs. Charles Denison, of Denver.

SELECTION of Portland, Ore., for the new northwest reforestation experiment station has been recommended by E. H. Clapp, assistant forester in charge of research at Washington, D. C. The new station will be the center of the most extensive forestry experimental work in the United States. Study will extend to problems on private timber holdings as well as on the national forest areas, and will include growth of trees, protection of young trees from fire and methods of cutting and brush burning to insure reforestation. All the leading timber of the northwest will be served from the Portland office, if the recommendation is accepted.

A NATIONAL Cancer Institute at Lima, Peru, was inaugurated recently by the president of the republic. Dr. Eladio Lanatta, a local physician, who has been making a special study of radiography in the United States, has been placed in charge of the new institution.

UNIVERSITY AND EDUCATIONAL NOTES

DRURY COLLEGE, Springfield, Missouri, has received $100,000 from an anonymous donor.

BY the will of the late Mrs. N. F. McCormick, Tusculum College, Tennessee, will receive $100,000, Princeton University $20,000 and the Allahabad Agricultural Institute of India $3,500.

FOUR new buildings become available at Ohio State University with the opening of the fall quarter. The buildings represent an expenditure of more than $1,000,000 and include a new administration building, commerce building, Hamilton Hall and the journalism building.

FUH TAN UNIVERSITY, Kiangwan (Shanghai), China, has been given $100,000 for a psychology building. The building is to be of stone, three stories high, 50 ft. by 120 ft. Dr. Zing Yang Kuo, who was trained in psychology at Columbia University and the University of California, is head of the department of psychology at Fuh Tan University.

DR. LEMUEL H. MURLIN, for thirteen years president of Boston University, has accepted the position of president of DePauw University, Indiana.

THE trustees of Worcester Polytechnic Institute have offered the presidency of the institution to Rear Admiral Ralph Earle to succeed Dr. Ira N. Hollis, who handed in his resignation two years ago to take effect on the choice of a successor.

AT the University of Kansas Dr. Dinsmore Alter, formerly associate professor of astronomy, has been appointed professor of astronomy in the department of physics and astronomy. He spent the past academic year in study and research in the California Institute of Technology while on leave of absence from the University of Kansas.

PROFESSOR WILLIAM J. MILLER has resigned as head of the department of geology in Smith College to become professor of geology and chairman of the department in the University of California, Southern Branch, Los Angeles.

DR. SHEPHERD IVORY FRANZ has resigned his positions at St. Elizabeths Hospital and George Washington University and will be associated with the department of psychology of the University of California, Southern Branch, Los Angeles.

AT the University of South Carolina Dr. Laurence L. Smith has been appointed associate professor of geology and Mr. Fred R. Neumann instructor in geology.

DR. GEORGE N. BAUER has been appointed associate professor of mathematics at the University of New Hampshire.

DR. H. W. RICKETT, instructor in botany at the University of Wisconsin, has been appointed assistant professor of botany at the University of Missouri.

AT a recent meeting of the Board of Regents of the University of Nebraska, the following appointments to the College of Medicine were confirmed: Dr. Harold Gifford, professor of ophthalmology, emeritus; Dr. James M. Patton, professor of ophthalmology and chairman of department; Dr. O. M. Cope, assistant professor of physiology and pharmacology; Dr. Herman F. Johnson, clinical assistant in orthopedic surgery; Dr. A. R. Knode, secretary of the department of laryngology; Dr. Chas. F. Moon, instructor of obstetrics and gynecology; Dr. A. E. Bennett, clinical assistant in neurology; Dr. M. Grodinsky, clinical assistant in surgery; Dr. Walter Benthack, fellow in pathology. The regents also created the department of clinical investigation and Dr. Arthur D. Dunn was appointed professor and chairman of this department.

SIR GILBERT WALKER has been appointed professor of meteorology at the Imperial College of Science, England, in succession to Sir Napier Shaw.

DR. WILHELM STEPP, professor of internal medicine at the University of Giessen, who is doing research work at Baltimore, has been appointed professor at the University of Jena following the resignation of Professor Stintzings.

DISCUSSION AND CORRESPONDENCE

THE PRESSURE CAUSED BY A FLAME

PROFESSOR CARL BARUS[1] has recently described observations of what he at first took to be a pressure caused by the burning of the gas in an open flame, but which he now thinks is probably due to the increased viscosity of the heated gas near the point where it escapes from the orifice into the flame. This effect is one which I ran across a number of years ago,[2] and which at that time I attributed to a real pressure exerted by the flame.

My method was entirely different from that used by Professor Barus. I was feeding a small flame with gas from a small gasometer, and I noticed that when the flame was extinguished the gasometer bell fell more rapidly than when the flame was burning. The effect was the same as if the movement of the burning gas away from the point where it burned gave rise to a pressure.

Since Professor Barus's note appeared I have looked again for this effect, and in a couple of cases have examined roughly the magnitude of the effective back pressure. The gas was ordinary illuminating gas, and the nozzle at which the flame burned was a piece of glass tubing about 6 mm in inside diameter, drawn down at one end until the opening through which the gas escaped had a diameter of a little less than a millimeter. A number of readings of the height of the gasometer bell, taken while it was falling, showed that its rate of fall was nearly linear. The difference between the rate of fall when the flame is burning and when it is not burning may be surprisingly large. The following table shows the difference for two cases. It will be seen that when the gas was not

Condition	Rate of Fall, mm/sec.	
	Case 1	Case 2
Burning	0.084	0.140
Not Burning	0.126	0.189
Burning Again	0.082	0.141

burning the bell of the gasometer fell in the first case half again as fast as when the gas was burning. That is, in some way the burning slowed down the fall of the gasometer, as if the movement of the burning gas away from the point where it burned produced a pressure.

To get some idea as to the magnitude of this apparent pressure it is only necessary to reduce the load on the bell of the gasometer until the rate of fall when the gas is not burning equals the rate observed

[1] SCIENCE, 60, p. 137, August 8, 1924.

[2] Acoustic Repulsion of Jets of Gas, p. 29, Clark University Dissertation, 1913.

when the gas is burning. From the reduction in the load and the diameter of the bell the effective flame pressure can be obtained. My values are rough, but for the two cases shown in the above table they turn out to be about 0.18 mm of mercury and 0.37 mm of mercury. These are of the same order of magnitude as the values given by Professor Barus.

The question as to whether the effect is due entirely to the increased viscosity of the heated gas, or whether a true flame pressure has also something to do with it, is not easily answered. The observations reported by Professor Barus seem to indicate that the viscosity is important. A rough analysis of various factors which are involved suggests that for a given orifice the added pressure caused by the increased viscosity would be roughly proportional to the rate of efflux, and that a true flame pressure would also be roughly proportional to the rate of efflux. In the two cases cited above the ratio of the added pressures which were observed is 2.1, whereas the ratio of the rates of efflux is 1.7. These numbers differ sufficiently to suggest that perhaps neither factor alone is sufficient to explain the pressure but that both may be operative, that the added pressure may perhaps be due in part to the increased viscosity and also in part to a true flame pressure.

ARTHUR TABER JONES
SMITH COLLEGE

TO TEACHERS OF LABORATORY GENETICS

ASIDE from the now ubiquitous Drosophila, suitable material for laboratory work in genetics is not abundant. Occasionally in our research laboratories, forms are secured which are favorable for use in illustrating one or another fundamental genetical principle, and such material should be brought to the attention of teachers and made available for general use in teaching laboratories.

Cases in which dominance is definitely absent, giving rise to the monohybrid ratio 1 : 2 : 1, are relatively rare, and the classical examples of the Blue Andalusian fowl and the pink-flowered Mirabilis are not suitable for laboratory use.

Since the occurrence of dominance introduces a complicating factor in the analysis of hybrid progenies because it masks genotypic differences, destroying the parallel between the phenotype and the genotype, the 1 : 2 : 1 ratio gives a simpler approach to the typical Mendelian behavior than does the 3 : 1 ratio of the much more common case in which dominance is complete or nearly complete.

In my extensive studies of shepherd's purse (*Bursa bursa-pastoris*), I have found the usual prevalence of complete dominance, but in 1917 a peculiar form which has been designated *tenuiloba,* originated as a segregate in the F_2 of a cross between two wild strains of shepherd's-purse, derived, respectively, from Korea and from Landau, Germany, which has bred true when selfed, and which gives 1 : 2 : 1 ratios of *tenuiloba, heteris* and *rhomboidea* when crossed with a pure *rhomboidea.* The *tenuiloba* and *rhomboidea* segregates breed true and the *heteris* splits again as in the F_2. The *tenuiloba* form has the median lobes of the climax leaves of the rosettes reduced to slender bristles which diverge at a small angle from the rachis of the leaf, while the *heteris* in these families has the slender primary lobes diverging nearly at right angles to the rachis and each associated with a conspicuous secondary lobe. *Rhomboidea* has less conspicuous secondary lobing on an unelongated primary lobe.

As the three forms are very distinct, no difficulty is experienced in their accurate separation. This fact, together with the ease with which Bursa cultures are successfully handled, and the fact that the definitive stage in these forms occurs in the rosettes, thus making it possible to classify the segregates within a few weeks after the plants are transplanted from the seed-pan into three-inch pots, makes it entirely feasible to use this material in laboratory courses limited to a single semester.

To teachers who wish to diversify their laboratory work in genetics by the introduction of these forms, I am prepared to supply packets of selfed seeds of heterozygotes in such numbers as are likely to be called for. A smaller number of parcels of selfed seeds of the homozygous types is also available for those who wish to have at hand pure-bred families of these types, but as the *tenuiloba* and *rhomboidea* forms in the segregating families are pure homozygotes, it will not be *necessary* to have pure families in order to provide for the assured presence of homozygous material of the grandparental types.

No compensation is asked for this material except that the results of segregation found by students in each of the segregating families should be reported back to me, in order to contribute to a determination as to whether the slight deviations from the 1:2:1 ratio fall within limits which indicate that such deviations may be appropriately attributed to errors of random sampling.

Because of the presence of wild Bursa seeds in all ordinary soils, it is necessary in the handling of Bursa cultures to sow the seeds in sterilized soil. I make it a rule to grow 125 plants of each family in which a monohybrid ratio is expected. Greenhouse space of about one square meter must be provided, therefore, for each culture grown. The continuation of cultures for the use of subsequent classes will be very easily provided for by growing to maturity the requisite number of *heteris* plants (heterozygotes)

and placing a paper bag of suitable size over the inflorescence of each when ready to begin flowering, as the plants self-fertilize perfectly when thus treated.

In order to share in this distribution of material, applications should be made promptly, stating the number of parcels which the applicant is prepared to grow.

GEO. H. SHULL

PRINCETON, NEW JERSEY

THE PRESENT STATUS OF THE METRIC SYSTEM

IN SCIENCE, September 5, 1924, Professor Satterly, of the University of Toronto, takes exception to any plea for extended use of the metric system. His concluding argument is: "The trouble with men like Mr. McAdie is that because they like a thing they think all the world must agree with them." The professor doubtless means that some men when they have a good thing like to share it; and for the implied compliment we return thanks, although not sure we deserve such unstinted praise—and in public, too.

"I have been teaching physics in Toronto for the last twelve years and have introduced (*sic*) the English units more and more," says Professor Satterly. If his students are submissive, certainly others should not object. May the progress continue until the table of linear measurement beginning "three barley corns make an inch" is reached. Clean, dry, medium-sized corns, laid end to end. Later it can be determined how many corns make a yard, a rod, a rood, a perch, a pole or a chain.

The professor also prefers pounds, shillings and pence to the decimal money in use in Canada. He asks, "And how is it that the quarter is so popular?" The profound truth is—it is easier to get than a dollar; but if given a choice between accepting a quarter or a dollar, I know which one I'll take; and I fancy Professor John will do the same.

ALEXANDER MCADIE

BLUE HILL OBSERVATORY

HAVING been an interested reader of the various recent comments regarding the present status of the metric system as printed in SCIENCE, one or two additional observations may aid in clarifying the situation.

In the first place, why does not such a highly organized scientific group as that of the United States Weather Bureau discard the Fahrenheit thermometer with its freezing point 32 degrees above a zero which has no scientific meaning at the present time? A step in the right direction was shown in the weather map of the northern hemisphere prepared by the Weather Bureau during the early months of 1914 and suddenly discontinued on August 2 of that year when the warring nations of Europe stopped sending in the necessary data. Why not resume the publication of these maps and then adopt the same temperature scale or the common Celsius scale for the United States maps also?

Professor McAdie's arguments in SCIENCE for June 13 will be accepted without dispute by scientific workers. However, it should be borne in mind that the "cooks" and "carpenters" use the system taught them in the public schools and that very little attention is given to the metric system in the arithmetic classes of the common schools. This is due partly to the fact that a very large percentage of the teachers are not sufficiently familiar with that system to teach it effectively and in a larger degree it is neglected because neither teachers nor school supervisors have ever been convinced of its practicability and adaptability to everyday affairs. The metric system will never be generally adopted until the masses of the people are convinced of its practical value. The masses can most easily be reached through the rising generation in the common schools. The teachers can most easily be "sold" to the system if we can convince them that its use would save about a year's time in compound numbers in arithmetic. Men like Professor McAdie, who know the working advantages of the metric measures from constant daily use, have a real responsibility in bringing the matter to the attention of grade teachers, taking advantage of every opportunity that presents itself in normal schools, teachers' institutes and teachers' associations.

J. C. JENSEN

NEBRASKA WESLEYAN UNIVERSITY,
UNIVERSITY PLACE, NEBRASKA

GERMAN BIOLOGICAL PUBLICATIONS

THE claim is made that the price of German biological publications is no higher than many American and not so high as the English. May I ask SCIENCE to publish data that show the average cost per page of this library's most recent subscriptions to serial publications issued in four countries?

Country	Average Cost per page	No. Journals in estimate
America, U. S.	$.010	27
England	.0111 +	17
France	.006	8
Germany	.016 +	29

PRISCILLA B. MONTGOMERY

LIBRARY OF THE MARINE BIOLOGICAL LABORATORY,
WOOD'S HOLE, MASS.

THE PAN-PACIFIC RESEARCH INSTITUTE

A STATEMENT in SCIENCE for August 29, page 195, quoted from the press, to the effect that I "have tentatively accepted the directorship of the Pan-Pacific

Research Institute" at Honolulu, needs a word of correction. In case the hopeful project develops as expected, I may become for a time honorary president. In this case my chief duty would be to assist in finding a suitable young man as director. This may involve visits to Honolulu, but not continuous residence.

David Starr Jordan

SCIENTIFIC BOOKS

ANIMALS OF THE YOSEMITE

One of the most complete of local faunas, a monumental model of accuracy, fullness, clear expression and typographical excellence, has been lately issued by the University of California under the title of "Animal life in the Yosemite." The authors are Dr. Joseph Grinnell, curator of the Museum of Vertebrate Zoology, and his associate, Tracy Irwin Storer. This contains all that is known of the life history and habits of the 331 species of animals found in the Yosemite. This list includes 95 mammals, 54 of them being rodents, 231 birds, 22 reptiles and 13 amphibians. Each is accompanied by a compact description of "field characters," color, measurements and traits not demanding dissection, and a full record of all traits of behavior, distribution and relative abundance, together with excellent photographs and paintings. Nothing as satisfactory of its kind has ever been accomplished before. The authors observe that "every precaution has been taken to insure accuracy of fact and correctness of inference. No sacrifice of precision has been made consciously with the end merely to afford attractive reading. . . . Ideally we have tried to present our science, perfectly good science, in attractive form."

A single example may serve to show the method. The Tahoe Chipmunk (*Eutamias speciosus frater*) is one of seven species of these dainty little squirrels found in the Yosemite district. Seven pages are devoted to its behavior and distribution. From this I quote a single paragraph:

> The fact that the Tahoe Chipmunk is the only one of seven local species which habitually climbs high in the trees is a point of evidence that restriction to a particular type of habitat or mode of behavior does not always rest upon the possession of conspicuous special structural features of an adaptive nature. So far as can be seen by an examination of specimens in hand, none of the other species of chipmunks is physically incapacitated for tree climbing; in fact, individuals of these others are occasionally observed well up in the trees. There doubtless *are* minor features of structure, associated with a different psychology, which account for the differing traits indicated. Age-long segregation, in separate areas of differentiation, of the several stocks may be the basis of this divergence of habitat preference. The shifting of climatic barriers, with the resulting migrations of populations, has thrown the species together as very near neighbors or as actual companions. Fatal competition is prevented as a result of these initial predilections, whereby *frater* favors the trees, *alpinus* the rocks, and *senex* and *quadrimaculatus* the brush patches and logs.

The introduction closes with a fine plea for the study of living organisms, not as a substitute for anatomy, cytology, genetics and the like, but as a worthy end in itself and as the natural beginning for the development of naturalists. In the present "dry rot of academic biology," it is well to realize that animals and plants exist in nature and through knowing them students find their most attractive introduction to the study of biology.

Dr. Grinnell remarks:

> The study of natural history should develop the power of insight, keenness, not only in seeing what animals do, but in determining why these things are done.
>
> The interrelations between any animal and its environment are exceedingly manifold and vital. To understand these brings into play a superior type of intellectual activity, and, we believe, leads to enhanced powers of perceiving and solving human problems.

The authors may be sincerely congratulated on a noble piece of constructive work, and the university they represent on the far-sighted generosity which has permitted its completion, the Museum of Zoology itself being built up chiefly on the appreciative gifts of Miss Annie Alexander.

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SPECIAL ARTICLES

A TENTATIVE INTERPRETATION OF THE RADIOMETRIC DATA ON VENUS

In a recent communication in this journal were given the results of new radiometric measurements on Mars and Venus. For the sake of brevity no interpretation was then given to these data. It now seems desirable to add a few comments on our results, which, as previously stated, show that the unilluminated surface of Venus emits a relatively intense infra red radiation, that the southern hemisphere is hotter than the northern, and that the radiation emitted is highly selective. How are we to account for this condition? Water vapor is supposed to be absent; and if it were present it probably could not strongly emit radiation of wave lengths 8–15μ. Of the gases present only CO_2 and ozone could emit strongly in the region of 10.5μ. The rest must emanate from the solid surface of the planet.

If the rotation period is long then it seems necessary to assume that the surface of Venus is still highly heated and emits its own proper radiation.

If the rotation period is short then, owing to the relatively dense atmosphere, the heat would be retained for some hours after sunset, as obtains on this earth, which is less highly heated owing to its greater distance from the sun.

The fact that the southern hemisphere (the bright cusp as well as the adjoining dark region) is hotter than the northern (cusp and contiguous dark area) might be owing to a difference in surface conditions as observed on Mars. This difference in temperature may be owing to a tilting of the axis of rotation, a variation in insolation, and a consequent change in the seasons, as observed on the earth and on Mars. If this is the case then, in the course of time, temperature conditions should be reversed and the northern hemisphere should become the hotter. This, as well as several other questions, can not be answered without further observations extending over a long period.

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A NOTE ON THE RING METHOD OF MEASURING SURFACE TENSION

WHEN one consults tables of physical constants for the values of the surface tension of water in contact with air at a given temperature, one is struck by the variety of values given, depending upon the method used. The ring method has been criticized because the values given (Weinberg, duNoüy) although consistent among themselves, differ considerably from the values obtained by other methods. The average of values by the ring method at 15° is 76.6 dynes per centimeter, whereas a probable average of values by other methods at the same temperature is 73.4 dynes per centimeter. The difference of 3.2 dynes remains to be explained.

Fahrenwald[1] attempts an explanation of the high values obtained by the ring and similar methods, in stating that in addition to the true surface tension there is a force due to a column of liquid beneath the edge (ring) to which the liquid adheres; and that this column is supported, not by the surface tension, but by attraction between the edge (ring) and the liquid molecules. Although the explanation is correct for the equilibrium condition when the upward pull on the ring is much below that attained at the instant of rupture, it does not apply in the latter instance.

In our analysis of methods used in measuring surface tension we may logically assume that in any simple liquid, such as water, surface tension is a definite physical property which, under fixed conditions, should be quantitatively expressible with a degree of accuracy limited only by the experimental conditions. The outstanding difference of 3.2 dynes is a strong indication that a source of constant error, either in the ring method or in the other methods, must have been overlooked by the experimenters. Recently, in making measurements with the apparatus of duNoüy, the writer had occasion to determine if possible whether the difference might be attributable to the ring method or merely to the technique by which the measurements are made. That Fahrenwald's explanation is probably incorrect is shown by the fact that as the ring is pulled up out of the surface by the application of increasing force, there is a point at which the liquid adhering to the ring is suddenly drawn out into a thin annular film, several millimeters long, yet retaining stability. As the force is gradually increased the point is finally reached at which the film breaks. This film is so thin at the instant of rupture that an error of 3 dynes certainly can not be attributed to it. It is found further that after the ring has been pulled away, droplets adhere to it. DuNoüy has found (private communication) that the weight of these droplets for a given size of wire in the ring is very constant indeed, their weight amounting to about .24 dyne per centimeter length of wire for the size used in the duNoüy tensiometer. This value increases with increasing thickness of wire. Obviously the amount of liquid pulled away with the ring does not account for the difference of three dynes.

The following explanation is believed to be the correct one. As the ring is drawn out of the liquid the upward force on the ring, measured by the torsion of the wire, is just balanced by the weight of liquid elevated above the normal surface. It is important to note that the scale readings of the instrument are taken with reference to the scale zero, and that the scale zero corresponds with the actual zero of torsion only when the arm which carries the ring is in its position of zero-balance. As the ring is pulled higher with increasing force, the true zero on the scale, with reference to which readings should be taken, shifts upward from the scale zero by an amount which corresponds to the position of the arm. Consequently, at the instant the film ruptures, the scale reading will be too high.

A new technique has been devised whereby the vessel containing the liquid is gradually lowered, by means of the screw adjustment on the support, while the increasing force is being applied, all the while maintaining the arm in its position of zero-balance. Thus the scale zero remains the true zero, and therefore readings of the scale will correctly represent the force at the instant of rupture. The error due to the droplets adhering to the ring is easily corrected by

[1] J. O. S. A. and R. S. I., 6, 722, 1922.